

BELEMNITES MUCRONATUS LINK, 1807 (CEPHALOPODA, BELEMNITIDA): PROPOSED DESIGNATION OF A NEOTYPE UNDER THE PLENARY POWERS¹ Z.N.(S.) 1160

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The object of the present application is to ask the International Commission on Zoological Nomenclature to use its plenary powers to set aside all specimens contained in the type lot of *Belemnites mucronatus* Link, 1807, should these still be extant, as the cotypes and source of interpretation of that nominal species. The Commission is further asked to designate another specimen as the type of the said nominal species, which would be in harmony with its well established and now universally adopted interpretation. This action is necessary to avoid serious confusion and disturbance in the current taxonomic practice both on the specific and generic level coupled with the even more serious and confusing changes in the zonal nomenclature of the late Upper Cretaceous rocks of northern Eurasia currently based on this and allied *Belemnitella*-like forms. As will be shown below, the action proposed in this application is preferable to an attempt to select a neotype of *Belemnites mucronatus* Link, 1807, that would be valid under the ordinary Rules and at the same time in harmony with the current usage of this nominal species.

It is hoped that it will be possible for the Commission to rule early on the present application. The decision is urgently needed as the strict application of the normal Rules was requested recently by the discoverer (Wind, 1955, pp. 663-664) of the nomenclatorial invalidity of the currently accepted taxonomic usage. Other palaeontologists (Birkelund & Rasmussen, 1956) subsequently investigated the matter in detail and came to the same conclusion; they have, however, quite reasonably deferred any decision on the subject pending the outcome of the present appeal to the plenary powers of the Commission. The decision is also urgently required in connection with the expected completion of the relevant part of the "Treatise on Invertebrate Palaeontology."

The details relating to this case are set out in the following paragraphs.

1. Wind (1955, pp. 663-664) has recently reinvestigated the drawings of the specimen of *Belemnitella mucronata* (Link, 1807 sensu Schlotheim, 1813) given by Breynius (1732, *Tabula Belemnitarum*, fig. 1a, 2b), which has been unanimously considered to be the type specimen of this nominal species ever since the publication of Schlotheim's (1813, p. 111) work. He concludes that the figures concerned show morphological features peculiar to the representatives of the genus *Belemnella* Nowak, 1913. These features preclude their now generally accepted identification with *Belemnitella mucronata* of d'Orbigny (1840-42), Arkhangelsky (1912), Nowak (1913) and subsequent authors both on specific and generic level.

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At the same time, as pointed out by Wind (1955), these drawings indicate that the relevant specimen of *Belemnitella mucronata* (Link, 1807 sensu Schlotheim, 1813) was at least congeneric with the legitimate type specimen of *Belemnites lanceolatus* Schlotheim, 1813 (Breynius, 1732, *Tab. Belemnitarum*, fig. 7a). *Belemnites lanceolatus* Schlotheim, 1813 is, however, the type-species of the genus *Belemnella* Nowak, 1913. The genus *Belemnella* thus becomes a subjective junior synonym of the genus *Belemnitella* d'Orbigny, 1840. As further pointed out by Wind (1955), the above results leave *Belemnitella mucronata* of Arkhangelsky (1912), Nowak (1913) and all subsequent authors (including the writer) without a nomenclatorially valid generic name. Under normal nomenclatorial procedure a new generic name would have to be introduced for *Belemnitella mucronata* of these workers and for its allies. They are now generally grouped under *Belemnitella* d'Orbigny, as amended by Nowak (1913) and Jeletzky (1941), and amply deserve a generic name (see Jeletzky, 1941, 1951b, 1955, and in the following paragraphs).

2. According to Birkelund & Rasmussen (1956), the specific name *Belemnites mucronatus* was first published by Link (1807). Link's indication was, however, insufficient to identify this species with any degree of precision, and he gave neither a figure of his species nor any reference to a previously published figure of the same.

Birkelund & Rasmussen (1956) conclude further that Schlotheim (1813, p. 111) was the first revising author of this species; he indicated the figures of Breynius (1732, *Tab. Belemnitarum*, Fig. 1a, 2b) and those of Faujas (1798) as examples of *Belemnites mucronatus*, thus making them its syntypes. No formal selection of the lectotype from among these specimens is known to the writer. Subsequent workers have, however, invariably considered the aforementioned figures of Breynius (1732) as the type specimen of *Belemnites mucronatus*, while invariably considering Schlotheim (1813) to be its author. This latter opinion was, however, rejected by Birkelund & Rasmussen (1956).¹

3. The generic name *Belemnitella* was first published by d'Orbigny (1840, p. 59) in 1840; he did not designate a type species for his genus and assigned three nominal species *Belemnitella mucronata*, *Belemnitella Scaniae* (= *Belemnites mammillatus* Nilsson, 1817), and *Belemnitella quadrata* to it. *Belemnites mucronatus* was, however, formally selected as the type-species of *Belemnitella* by

¹ Mr. L. Bairstow, British Museum (Natural History) considers, however (written communication of May 5, 1957), that there is no conclusive evidence that *Belemnites mucronatus* of Schlotheim (1813) was more than a (possibly non-synonymous) junior homonym of *Belemnites mucronatus* of Link (1807), as Schlotheim did not indicate his knowledge of Link's work anywhere in his publication. He disputes, therefore, Birkelund's & Rasmussen's (1956) conclusion that Schlotheim (1813) was the first revisor of the species and that Breynius's (1732) specimens are legitimate syntypes of Link's (1807) *Belemnites mucronatus*.

Although there is no irrefutable evidence either for or against this assumption, the writer believes with Birkelund & Rasmussen (1956) that Schlotheim (1813) must have known Link's (1807) works, has knowingly used Link's specific name, and has revised his ill-defined species. He feels strongly, furthermore, that no useful purpose would be served by trying to achieve a solution of this complex and obscure problem that would be at the same time valid under the ordinary Rules and in harmony with modern usage. It is vastly preferable to settle it automatically once and for ever by the use of the plenary powers of ICZN as asked for in this appeal.

Herrmannsen (1846, p. 105) and was always so regarded by subsequent workers (e.g. Naef, 1922, p. 255).

All *Belemnitella*-like forms figured by d'Orbigny (1840, pl. 7, fig. 1-8) as examples of *Belemnitella mucronata* were, however, subsequently found to be quite distinct from its generally recognized type specimen designated by Schlotheim (1813), which was cited by d'Orbigny as one of the examples of *Belemnitella mucronata*. The subsequent workers to be discussed in the following paragraphs have, unfortunately but not unnaturally, tended to interpret the nominal species *Belemnitella mucronata* and the genus *Belemnitella* by the examples figured by d'Orbigny (1840). This attitude was greatly facilitated by the fact that d'Orbigny's (1840) work was much better known and more easily accessible than those of Breynius (1732) and Schlotheim (1813).

An extreme but illuminating case is that of Lange (1921, pp. 25-26). This worker, being unable to procure a copy of Breynius's (1732) work and being struck by the poor quality of the Faujas (1798) figure, actually proposed to consider d'Orbigny (1840) as the author of the nominal species *Belemnitella mucronata*. Similarly, Naidin (1952) has refused to credit Schlotheim (1813, 1820) with the authorship of the species *Belemnites lanceolatus* and proposed to consider Sinzov (1872) as its author.

The above discussed action of d'Orbigny (1840) appears, therefore, to be the original source of the nomenclatorial and taxonomic confusion discussed in the following paragraphs.

4. The generic name *Belemnella* was published by Nowak (1913, pp. 393, 403) as a subgenus of the genus *Belemnitella* d'Orbigny, 1840 emend. Schlüter, 1876. Although not indicated as such by Nowak (1913), *Belemnites lanceolatus* Schloth., 1813 was formally designated as the type-species of the subgenus *Belemnella* by Bülow-Trummer (1920, p. 195).

Nowak (1913, pp. 393, 395) simultaneously restricted the subgeneric name *Belemnitella* s. str. to the Upper Campanian and Maestrichtian *Belemnitella*-like forms. These forms are essentially similar to those figured by d'Orbigny but rather distinct morphologically from the unanimously recognized type specimen of *Belemnites mucronatus* (Link, 1807 sensu Schlotheim, 1813). Nowak (1913) has, like so many other authors, completely overlooked the above differences. Also some other *Belemnitella*-like forms (*Belemnitella praecursor* Stolley, *Belemnitella americana* (Morton), *Belemnitella mirabilis* Arkhangelsky) were placed in the subgenus *Belemnitella* s. str. by Nowak (1913). All these forms are congeneric with the specimens of *Belemnitella mucronata* figured by d'Orbigny (1840) but not with *Belemnites mucronatus* (Link, 1807 sensu Schlotheim 1813) as interpreted by its generally recognized type specimen.

Bülow-Trummer (1920, p. 188, 195) recognized the validity of the subgeneric names of Nowak (1913) in the Dibranchiata part of the *Fossilium Catalogus*.

Jeletzky (1941, pp. 28-30, fig. 1-4) has demonstrated that the groups of *Belemnitella*-like forms designated respectively as subgenera *Belemnella* and *Belemnitella* s. str. by Nowak (1913) and already previously referred to as the groups of *Belemnitella mucronata* and *Belemnitella lanceolata* by Arkhangelsky (1912, p. 622-623) differ sharply from one another in several important mor-

phological features. Taken together with the only morphological distinction of these subgenera listed by Nowak (1913, pp. 391–392), these morphological features were found to be ample for the recognition of these species groups as independent genera of the family Belemnitellidae Pavlow, 1914 by the majority of specialists concerned. Like his predecessors Jeletzky (1941) failed to notice that the morphological features of all forms placed in the genus *Belemnitella* s. str. are in contradiction with those of the generally recognized type-specimen of its type-species (see above). Jeletzky also failed to recognize this distinction in his later publications on the subject. He (Jeletzky, 1949, p. 262) recognized, however, the complete morphological correspondence between the type specimen of the legitimate type-species of the genus *Belemnella* Nowak, 1913 and the *Belemnitella*-like forms placed into this species (*Belemnites lanceolatus*) by modern authors recognizing its independence.

5. After the revision of the genera *Belemnitella* s. str. and *Belemnella* by Jeletzky (1941, 1946, 1948a, 1949, 1951b), these names in the sense of Nowak and Jeletzky have been accepted and used stratigraphically by the majority of English, west-European, German-Scandinavian, North American and Russian specialists concerned (e.g. Wright & Wright, 1951, pp. 3, 10; Voigt, 1951, 1954; Schmid, 1951, 1953, 1955a, b; Seitz, 1952; Troelsen, 1955; Wicher, 1953; Bettenstaedt & Wicher, 1955; Reyment, 1956, pp. 41–42; Birkelund, 1957; A. Müller, 1951, pp. 28–29, pl. IV; 1952, p. 375, pl. I, fig. 1; Lowenstam & Epstein, 1954, pp. 245; Lowenstam, 1954, p. 299; Hiltermann, 1952, pp. 47, 60–61, 63; Hiltermann & Koch, 1950, pp. 597, 1955, pp. 358–363; Nadin, 1951, 1952, 1954, 1959). These genera were, furthermore, accepted in the same sense in the most important modern Treatise of Palaeontology edited by Piveteau (Roger, 1952, pp. 721–722, fig. 52–53) and in Müller's (1960, pp. 267–8, text figs. 388–93) Text book of Palaeontology. Among recent workers only Vassilenko and Rasmyslova (1950), Nikitin (1958) and Kongiel (1962) have questioned the taxonomic validity of the genus *Belemnella*. Until the appearance of the paper by Wind (1955) none of the above workers had any idea about the nomenclatorial invalidity of this usage.

6. The specific names *Belemnites mucronatus* and *Belemnitella mucronata* were mostly applied loosely to several *Belemnitella*-like forms of Northern Eurasia and North America after the appearance of Schlotheim's (1813, 1820) works and until the first quarter of the 20th century. This usage became especially widespread subsequently to the appearance of d'Orbigny's (1840) work. During this period *Belemnites lanceolatus* Schlotheim, 1813 was mostly placed in the synonymy of *Belemnites mucronatus* sens. lat. (see Jeletzky, 1949, pp. 262–266).

7. Arkhangelsky (1912, pp. 600–606, pl. IX, fig. 3, 9, 23, 26; pl. X, fig. 10) was the first worker to restrict the name *Belemnitella mucronata* to one of the several *Belemnitella*-like forms previously lumped under that name. This worker expressly restricted this specific name to the *Belemnitella*-like form occurring in the latest Lower Campanian and Upper Campanian (= Mucronatenschichten; see Jeletzky 1948b, pp. 587, 592) rocks of eastern Russia and other regions of northern Eurasia. He, furthermore, expressly assigned the *Belemnitella*-like forms occurring in the overlying Lower Maestrichtian and Upper Maestrichtian rocks of eastern Russia respectively to *Belemnitella*

lanceolata (Schlotheim, 1813) and *Belemnitella americana* (Morton, 1830). The *Belemnitella*-like forms of the underlying older Lower Campanian and Santonian rocks of eastern Russia have been assigned to *Belemnitella praecursor* Stolley and *Belemnitella mirabilis* Arkhangelsky.

It must be stressed that Arkhangelsky (1912, pp. 600, 609) expressly stated that his Upper to late Lower Campanian *Belemnitella mucronata* is conspecific with Schlotheim's (1813) *Belemnites mucronatus*. Nor did he use any subspecific names for the Russian *Belemnitella*-like forms, to which he restricted Schlotheim's name. The description and figures given by Arkhangelsky (1912) are satisfactory and leave no doubt that he completely overlooked the morphological distinctions between his form and the generally recognized type specimen of *Belemnites mucronatus* Link, 1807 sensu Schlotheim, 1813. Arkhangelsky's (1912) *Belemnitella mucronata* is obviously different from this latter; it belongs together with the specimens of *Belemnitella mucronata* figured by d'Orbigny (1840) to the genus *Belemnitella* sens. str. in the sense of Nowak (1913) and Jeletzky (1941, 1948a, 1949, 1951b, 1955).

With the sole exception of Sinzov (1915), who has questioned the validity of Arkhangelsky's (1912) definition of *Belemnitella mucronata* and that of its zone, all subsequent Russian workers have accepted *Belemnitella mucronata* and other *Belemnitella*-like forms (including *Belemnitella lanceolata* Schlotheim, 1813) in the previously discussed sense of Arkhangelsky (1912). Arkhangelsky's (1912) zonal scheme for the Russian Upper Cretaceous rocks based on these *Belemnitella*-like forms was also found to be fully valid and was accepted by all subsequent Russian authors. The subsequent introduction of additional *Belemnitella langei* (see Jeletzky, 1948b, 1951b, pp. 93–98) and *Belemnella lanceolata* mut. *sumensis* (see Jeletzky, 1949, pp. 268–270) zones is quite irrelevant in this connection, as these *Belemnitella*-like forms were unknown to Arkhangelsky (1912). It should be noted, however, that Jeletzky (1940, 1941, 1946, 1948a–b, 1949, 1951a–b, 1955) was the only worker of the Russian school to use Nowak's (1913) nomenclature for the *Belemnitella*-like forms concerned, instead of the above discussed standard Russian nomenclature for the same.

The Russian stratigraphical, palaeontological and regional geological papers and monographs devoted to or touching upon the subject of *Belemnitella mucronata*, other *Belemnitella*-like forms, and their zones run into several hundreds. The most important publications which appeared prior to the Second World War, and some of the publications which have appeared after it, are listed by Jeletzky (1951b, pp. 135–142; 1955, pp. 503–509; 1958, pp. 42–46, 53–57, 113–129).

Because of their wide geographical distribution and stratigraphical importance, *Belemnitella mucronata* sensu Arkhangelsky, all other *Belemnitella*-like forms sensu Arkhangelsky, and their zones sensu Arkhangelsky have entered most of Russian text-books and treatises on stratigraphical palaeontology and historical geology, many Russian text-books and treatises of invertebrate palaeontology, and all Russian manuals of index fossils and regional stratigraphy. Some of these are listed by Jeletzky (1951b, pp. 135–142; 1955, pp. 503–509; 1958, pp. 113–129). In addition the following selection of these works, which happen to be available to the writer in Ottawa, can be given here:

(a) Standard treatises on general historical geology by Korovin (1940, pp 341–43; fig. 175–6), Strachov (1938, 2; 1948, 2, p. 220, 223, 207, pl. 25, fig. 7–8) and Masarovich (1937); (b) Masarovich's (1938, pp. 94–95, 129, 193, 297–298) Fundamentals of Geology of U.S.S.R.; Zhemchuzhnikov's (1934) Manual of Palaeofaunistics; Bodylevsky's (1955, pp. 121–122, pl. 68, figs. 267–269) Small Atlas of Index Forms of the U.S.S.R.

The following is a selection of the most important post Second World War Russian papers and monographs extensively dealing with or entirely devoted to the Russian Upper Cretaceous *Belemnitella*-like forms, which use *Belemnitella mucronata*, other *Belemnitella*-like forms, and their zones in the sense of Arkhangelsky (1912) with or without the above mentioned additions (Kabanov, 1950; Michailov, 1947, 1948, 1951; Savchinskaja, 1950, 1952; Sobolevskaja, 1951; Bushinsky, 1954; Morozov, 1952; Pasternak and Smirnova, 1948; Vassilenko & Rasmyslova, 1950; Naidin, 1951, 1952, 1954, 1955, 1959). It should be stressed that Arkhangelsky's usage of these Upper Cretaceous belemnites and their zones is still the only one used in Russia and that all the above mentioned modern Russian authors refuse steadfastly to use the nomenclature of the *Belemnitella*-like forms used by Nowak (1913) and Jeletzky (1940–1955) discussed in the following paragraph.

8. In addition to having introduced the generic name *Belemnella* and restricting the generic name *Belemnitella*, Nowak (1913) produced a revision of the Polish late Upper Cretaceous *Belemnitella*-like forms, which is rather similar to that previously worked out by Arkhangelsky (1912) in several respects. Nowak (1913, pp. 390–393, 395–402, pl. 42, fig. 18–19, 21, 22, 25–26) did not restrict, however, the name *Belemnitella mucronata* to the *Belemnitella*-like form of the Upper Campanian rocks as Arkhangelsky (1912) did. He, instead, identified the Polish Upper Campanian *Belemnitella*-like form as *Belemnitella mucronata* (Schloth.) mut. senior Nowak, 1913. Nowak (1913, p. 397), furthermore, pointed out that his *Belemnitella mucronata* mut. senior may be distinct from *Belemnitella mucronata* of Arkhangelsky (1912). The closely related *Belemnitella*-like form occurring in the Upper and (?) Lower Maestrichtian rocks of Poland and western Europe was named *Belemnitella mucronata* (Schloth.) mut. junior Nowak 1913. When designating these two *Belemnitella*-like forms as new mutations of *Belemnitella mucronata* (Schloth.) Nowak has, of course, nomenclaturally separated them both from Link's (1807) species *Belemnites mucronatus*. As far as his *Belemnitella mucronata* mut. senior is concerned, this is even more strongly stressed by his above mentioned doubts as to its identity with *Belemnitella mucronata* of Arkhangelsky (1912).

Except for its assignment to the new subgenus *Belemnella*, Nowak used *Belemnella lanceolata* (Schloth.) and its zone in the same sense as Arkhangelsky (1912) did.

The *Belemnitella*-like species and mutations described by Nowak (1913) were almost immediately accepted by most Polish authors (e.g. Rogala, 1916; Siemiradzki, 1928; Skolozdrówna, 1929, 1932; Kongiel, 1935, 1937; Rózicki, 1938; Pożarski, 1938, 1948; Pożarska & Pożarski, 1951; Putzer, 1942). They are still in common use in Poland, and even workers who have stated their disagreement with Nowak's belemnite nomenclature and taxonomic conclusions

(e.g. Kongiel, 1937, p. 5, 1962; Pożariski 1938, pp. 44–45) have continued to use his belemnite species and mutations.

The belemnite zonal table of Nowak (1913, 1917) proved to be unsatisfactory in several respects. Its validity was almost immediately questioned by Rogala (1916). Subsequently it was revised by Skolozdrówna (1929, 1932), Pożariski (1938) and Jeletzky (1948b, 1951b). The last mentioned worker has finally (1951b) arrived at a belemnite zonal scheme, which appears to be valid (except in some details) for the Upper Campanian and Maestrichtian rocks of England, western Europe, German-Scandinavian region, and Poland and is now used by most workers of these countries.

Further details of the vagaries of Nowak's (1913, 1917) belemnite zonal scheme and his admittedly unfortunate belemnite nomenclature are irrelevant for the purpose of this appeal. From its standpoint it is only important that Nowak (1913, 1917) has restricted the name *Belemnitella mucronata* to the same group of *Belemnitella*-like forms as Arkhangelsky did, while at the same time having generically separated them from *Belemnites lanceolatus* Schlotheim, 1813. This nomenclatorially incorrect action was generally accepted by the Polish specialists concerned. Consequently in Poland (as well as in Russia since Arkhangelsky, 1912) the name *Belemnitella mucronata* has come to mean this particular group of forms to the majority of Polish palaeontologists and geologists concerned since the time of publication of Nowak's (1913, 1917) results. Like their Russian colleagues, these Polish geologists and palaeontologists were unaware of the nomenclatorial invalidity of this concept of *Belemnitella mucronata* until the appearance of Wind's (1955) paper.

9. Prior to Jeletzky's (1946, 1948a–b, 1951a–b, 1955, 1958) attempts to apply the above discussed Russian-Polish palaeontological and stratigraphical results to England, west-European countries and northwest-European countries, there was no generally recognized concept of restricted *Belemnitella mucronata* and other *Belemnitella*-like forms in any of these countries. Nor was there any attempt to use *Belemnitella mucronata* or any other *Belemnitella*-like forms for the purposes of detailed zonal stratigraphy. Since the appearance of the above papers of Jeletzky, however, the principal Polish-Russian results were accepted by the majority of workers of these countries (e.g. Wright & Wright, 1951, pp. 3, 10; Voigt, 1951, 1954; Schmid, 1951, 1953, 1955a–b; Seitz, 1952; Troelsen, 1955; Wicher, 1953; Bettenstaedt & Wicher, 1955; Reyment, 1956, pp. 41–42; A. Müller, 1951, pp. 28–29, pl. IV, 1952, p. 375, pl. I, fig. 1; Hiltermann, 1952, pp. 47, 60–61, 63; Hiltermann and Koch, 1950, p. 597, 1955, pp. 358–363; Hägg, 1954, p. 60; Hagn, 1953; Grube, 1955). These results were, furthermore, accepted in the most important modern Treatise of Palaeontology edited by Piveteau (Roger, 1952, pp. 721–723, fig. 52–53), Müller's (1960) Textbook of Palaeontology and in the last edition of Kayser's Abriss der Geologie (Brinkman, 1954, Table opp. p. 220).

Although not as deeply rooted as in Russia and Poland, the above discussed nomenclatorial-taxonomic usage of *Belemnitella mucronata*, of other *Belemnitella*-like species, and of their zones is now generally adopted also in all west-European and northwest-European countries, and in England. This usage was, furthermore, by no means unknown in west-European and north-west European

countries prior to its introduction thereto. Already Bülow-Trummer (1920) had expressly adopted the Russian-Polish nomenclature of the *Belemnitella*-like forms in his Dibranchiata part of the Fossilium Catalogue, although being inaccurate in many details of synonymy of the species concerned. Also Bubnoff (1926, pp. 182-183; 1935, pp. 967, 989, 990, 1004); Stolley (1928, p. 116), Daque (1942, p. 78, pl. 37, fig. 4; pl. 39, fig. 7), Riedel (1942, p. 24; 1950) and Hägg (1947, pp. 97-99) recognized it at least in part. These authors did not believe, however, that these *Belemnitella*-like forms occurred commonly in west- and northwest-european countries and that the east-european belemnite zonal table could be equally well applied there (e.g. Bubnoff, 1935, p. 967; Riedel, 1950, p. 384). Therefore little attention was paid to the Russian-Polish taxonomical and stratigraphic results until they were shown to be applicable to northwest-european and west-european countries and to England.

10. It should also be stressed that whatever usage there was in west-european and northwest-european countries, and in England prior to introduction of the Russian-Polish palaeontological and stratigraphical results into these countries, this usage has tended to restrict the use of the name *Belemnitella mucronata*, Link, 1807 to the same group of forms as in Poland and Russia; that is to *Belemnitella*-like forms with large Schatsky Index and other features characteristic of the genus *Belemnitella* d'Orbigny, 1840 as amended by Nowak (1913) and Jeletzky (1941).

Already Sowerby (1829, pp. 205-207, pl. 600, fig. 1-2, 4) had figured under the name of *Belemnites mucronatus* only such *Belemnitella*-like forms from the Norwich Chalk. According to Birkeland & Rasmussen (1956) the same applies to Nilsson (1827). As already mentioned, d'Orbigny (1840), the author of the genus *Belemnitella*, figured under the name of *Belemnitella mucronata* only such Upper Campanian and Maestrichtian forms with large Schatsky Index and other morphological features of *Belemnitella* in the sense of Nowak (1913) and Jeletzky (1941). The same is true of the monographs of Sharpe (1853-57), Moberg (1884, 1896) and many other monographs and papers dealing with this group of belemnites.

Instances where forms with the small Schatsky Index and other morphological features of the genus *Belemnella* in the sense of Nowak (1913) and Jeletzky (1941) were figured under the name of *Belemnites mucronatus* together with the previously discussed forms or alone are much less numerous (see Jeletzky, 1949, pp. 263-266). It is, furthermore, quite obvious in all such instances that inclusion of these forms did not represent the intention of these workers to correct the longstanding nomenclatorial misinterpretation of *Belemnites mucronatus*, Link sensu Schlotheim, 1913. The inclusion of these *Belemnitella*-like forms into *Belemnites mucronatus* Link, 1807 merely reflected the already mentioned traditional lumping of all or most of the *Belemnitella*-like forms under the collective name *Belemnites* or *Belemnitella "mucronata"* by English, west-european, and northwest-european workers.

A good example is provided by Naef's (1922, p. 201, 255, fig. 70a-d) reproduction of *Belemnella lanceolata* sens. lat. under the name of *Belemnitella mucronata* (Schloth.) cited by Wind (1955, p. 663) as an example of the nomenclatorially correct use of this name in west-european literature. Although

Naef's figure of *Belemnitella mucronata* represents a *Belemnella lanceolata* sens. lat. (actually *Belemnella lanceolata* mut. junior Nowak, 1913) in the sense of Nowak (1913) and Jeletzky (1941), its choice is obviously accidental. Naef (1922, p. 255) cites, indeed, Zittel's specimen belonging to *Belemnitella mucronata* sensu Arkhangelsky 1912 as another example of this species. He states, furthermore, that: "an dieselbe [that is a *Belemnitella mucronata*; writer's remark] schliessen sich mehrere ähnliche Arten des Senon, mehr oder wenig keulenförmig gestreckt (*B. mucronatus* Schloenbach, 1867) bzw. zylindrisch verkürzt (*B. Hoeferi* Schloenbach, Taf. 16, fig. 1)". As shown by Jeletzky (1949, p. 264), the *B. mucronatus* of Schloenbach (1867, pl. 16, fig. 2), cited by Naef as specifically distinct from the *Belemnitella mucronata* he figures, is a rather typical *Belemnella lanceolata* (Schloth.) in the sense of Nowak and Jeletzky. Far from intending to use the name *Belemnitella mucronata* in the nomenclatorially correct sense, Naef (1922) apparently intended to restrict it in the sense of Arkhangelsky, Nowak, and Jeletzky and to separate *Belemnella lanceolata* from it.

11. It is obvious from the details given in the preceding paragraphs that the results of strict application of the Rules in this case would be disastrous on a generic level. Being the subjective junior synonym of the genus *Belemnitella* d'Orbigny, 1840 the accustomed and widely used generic name *Belemnella* Nowak, 1913 would have to be placed into synonymy of the former name. What is even worse, the name *Belemnitella* would have to be used for the taxonomically and stratigraphically important group of species now generally known under the name *Belemnella* instead of being used for another equally important species group, which is now generally known under the name *Belemnitella*.

The group of forms now universally known under the generic name of *Belemnitella* would be left without a legitimate generic name and would have to be renamed. These taxonomically disastrous results of the strict application of the Rules resulting in exchange of these two generic names would be further aggravated by the fact that these genera are stratigraphically important. Consequently they are constantly used by stratigraphers, structural geologists and other related specialists throughout northern Eurasia and also in North America.

As demonstrated in previous paragraphs, the results of the strict application of the Rules would be equally devastating at specific level. The generally accepted interpretation of the well known and stratigraphically important specific name *Belemnitella mucronata* would have to be changed. This name would have to be transferred to cover another *Belemnitella*-like form belonging to a different genus and occurring in a much younger zone (late Lower Maestrichtian). The widespread and stratigraphically important Upper Campanian *Belemnitella*-like form now generally known under the name *Belemnitella mucronata* (Schloth.) would have to be renamed. It is not at all clear which of its subjective junior, and mostly completely unfamiliar, synonyms would have to take its place under the Rules. Any of the possible selections would be quite unsatisfactory and would cause hardship to the palaeontologists, stratigraphers and related specialists concerned in using the name *Belemnitella mucronata* for the aforementioned *Belemnitella*-like form.

This action would completely disrupt the by now well established zonal scheme of the boreal late Upper Cretaceous (Upper Campanian and Maestrichtian) rocks of Eurasia, which is now used by most workers from Western Siberia to England.

In other words, 52 years of gradually developing palaeontological and stratigraphical terminology which has finally become thoroughly established and almost unanimously adopted on a global scale, would be overturned by the strict application of the Rules in this case.

12. The writer considers that the above discussed officially invalid nomenclature of Upper Campanian and Maestrichtian *Belemnitella*-like forms now in common use has become so firmly entrenched in the palaeontological and stratigraphical literature, and has so deeply penetrated the technical, as well as the general, geological literature that nothing but instability and confusion would result from an attempt to apply the ordinary Rules in this case. Such a request recently made by Wind (1955, pp. 663-664) is, therefore, quite unreasonable.

It must be stressed that the application of the ordinary Rules in this case is likely to result in the transfer of the well known generic names *Belemnitella* and *Belemnella*, as well as that of the well known specific name *Belemnitella mucronata* (see under 13), and the "transference of well known names from one genus and species to another" has been specifically mentioned by the International Commission on Zoological Nomenclature as one of the most important reasons for the suspension of Rules and the preservation of the affected generic and specific names under the plenary powers (see Opinions and Declarations rendered by I.C.Z.N., Declaration 5, publ. in 1943, p. 34).

13. Wind's (1955, pp. 663-664) demand for the strict application of normal Rules is based on the incorrect assumption that Schlotheim's (1813, p. 111) examples of *Belemnites mucronatus* are the legitimate cotypes of this nominal species. It was, however, pointed out to the writer first by Mr. L. Bairstow and then again by Miss Margaret Spillane that the Breynius (1732, fig. 1a, 2b) specimens of *Belemnites mucronatus* are not types of Link's species—however much they have been mistakenly regarded as such. If, as the writer assumes (see under 2), Schlotheim's (1813, p. 111) *B. mucronatus* was merely a citation of Link's (1807) name, his examples of the same have no possible bearing on the unfigured type(s) of Link's species. If, on the other hand, Schlotheim's (1813, p. 111) *B. mucronatus* was a new name unrelated to Link's (1807) *B. mucronatus* (as Mr. L. Bairstow assumes; see under 2) then it is nomenclaturally invalid as a junior homonym of the latter. No useful purpose would, in the writer's opinion, be served by an attempt to designate a neotype for *Belemnites mucronatus* Link, 1807 under the provisions of normal Rules. Such an attempt is obviously apt to cause even more confusion than an attempt to recognize Schlotheim's (1813, p. 111) examples of *Belemnites mucronatus* as the valid types of this nominal species. Even if they should still exist, which is most doubtful, Link's (1807) syntypes of this insufficiently defined species could easily represent any of the twenty or more of the valid species (belonging to any one of at least four valid genera) of the family Belemnitellidae. Worse even, they could equally well belong to some unrelated Lower Cretaceous or Jurassic belemnite

species, many of which have distinctly mucronated apical ends of the guards. Furthermore, nothing is known of the type locality of *Belemnites mucronatus* Link, 1807. It would, therefore, be quite inadvisable to start a slow and time consuming search for a neotype of *B. mucronatus* Link that would be at the same time acceptable under the normal Rules and in harmony with the now customary interpretation of this nominal species. This application specifically requests, therefore, a designation of the neotype of the nominal species of *Belemnites mucronatus* Link, 1807 that would be in harmony with its existing usage under the plenary powers *but not* the selection of a neotype of the same in accordance with the relevant provisions of the normal Rules. It must be stressed, finally, that there are recent precedents for the course of action requested in this application (e.g. Z.N.(S.) 514 and 533 submitted by Mr. C. W. Wright).

14. The following colleagues were consulted in the course of the preparation of the present application and kindly allow the writer to state that they are in general agreement with the recommendations now submitted for consideration by the I.C.Z.N.: Prof. Dr. E. Voigt, Director, Geologisches Staatsinstitut Hamburg; Prof. Dr. O. Seitz and Dr. Fr. Schmid, Amt für Bodenforschung, Hannover; Prof. Dr. H. Schmidt, Geologisch-Paläontologisches Institut der Universität Göttingen; Dr. T. Birkelund, Mineralogical and Geological Museum, Copenhagen; Dr. H. Wienberg-Rasmussen, Mineralogical und Geological Museum, Copenhagen.

The writer was, furthermore, advised by Prof. Dr. E. Voigt that the Paläontologische Gesellschaft has decided to support the above recommendations after their thorough consideration at its Wilhelmshaven meeting in September, 1956.

Mr. Leslie Bairstow, British Museum (Natural History) has kindly arranged the loan of the collection of *Belemnites mucronata* sensu Arkhangelsky, 1912 from Edward's Pit, Mousehold Heath, England and provided the writer with photographs of its specimens published in the Appendix; he has, furthermore, kindly read the original text of this application and made several valuable comments and criticisms of the same. Some of his criticisms were further commented upon in the previous paragraphs of this application. Miss Margaret Spillane, Scientific Assistant to the International Commission on Zoological Nomenclature, British Museum (Natural History) has made valuable comments and criticisms of the original text of the application. Some of these have been used in its final draft and commented upon in section 13 of the application.

The International Commission on Zoological Nomenclature is therefore asked:

- (1) To use its plenary powers to set aside all specimens contained in the type series of *Belemnites mucronatus* Link, 1807, should these still be extant, as the cotypè and source of interpretation of this nominal species.
- (2) To use its plenary powers to designate the specimen BM. C-43542 described and figured in the Appendix as the neotype of the nominal species *Belemnites mucronatus* Link, 1807. The reasons are given in the Appendix.

- (3) To place the under-mentioned generic names on the Official List of Generic Names in Zoology:
- (a) *Belemnella* Nowak, 1913 (type-species *Belemnites lanceolatus* Schlotheim, 1813 by subsequent designation by Bulow-Trummer, 1920, p. 195) (gender of generic name: feminine).
 - (b) *Belemnitella* d'Orbigny, 1840 (type-species *Belemnites mucronatus* Link, 1807 as proposed under (2) above, to be defined under the plenary powers) (gender of generic name: feminine).
- (4) To place the under-mentioned specific names on the Official List of Specific Names in Zoology:
- (a) *lanceolatus* Schlotheim, 1813 (as published in the binominal combination *Belemnites lanceolatus*) (type-species of *Belemnella* Nowak, 1913).
 - (b) *mucronatus* Link, 1807 (as published in binominal combination *Belemnites mucronatus*) as proposed under (2) above, to be defined under the plenary powers (type-species of *Belemnitella* d'Orbigny, 1840).
- (5) To place the under-mentioned family-group name on the Official List of Family-Group Names in Zoology:
Belemnitellidae Pavlow, 1914 (type-genus *Belemnitella* d'Orbigny, 1840).

APPENDIX

NOTE ON *BELEMNITELLA MUCRONATA* (LINK, 1807) SENSU ARKHANGELSKY, 1912 AND ITS PROPOSED NEOTYPE

Introduction

Most modern workers (e.g. Birkelund, 1957; Jeletzky, 1958; Kongiel, 1962; Naidin, 1956, 1959; Nikitin, 1958; Peake & Hancock, 1961) agree that the species *Belemnitella mucronata* should be interpreted in the sense of Arkhangelsky (1912). Under this, now customary, interpretation the large but fairly slender and long, strongly sculptured and distinctly mucronated *Belemnitella*-like form characteristic of the lower and middle part of the so called *mucronata* beds in the restricted sense (Jeletzky, 1958; Peake & Hancock, 1961) of northern Eurasia is considered to be typical of the species. This form is thus characteristic of the latest Lower to mid-Upper Campanian in terms of the international standard stages.

Except for Kongiel (1962), all workers concerned have agreed that the only reasonably complete specimen of *Belemnitella mucronata* figured by Arkhangelsky (1912, pl. IX, figs 3, 9; pl. X, fig. 10) is a typical representative of its above mentioned form. This specimen should, thus, normally have been selected as its type. This being impractical for reasons given below, this note is devoted to the description and illustration of a proposed neotype specimen of *Belemnitella mucronata* sensu Arkhangelsky, 1912 and its typical subspecies. The name *B. mucronata mucronata* Naidin, 1956, is used herein for this form.

Proposed neotype specimen

Grounds for selection. As already suggested by Naidin (1956, p. 19) and Birkelund (1957, p. 30), the already mentioned specimen of *B. mucronata* figured by Arkhangelsky (1912) should be selected as its type. Kongiel (1962, p. 30) has pointed out, however, that none of the generically diagnostic internal features is actually known for this specimen. He has accordingly proposed to: "accept, as a tentative solution of this problem, as holotype the specimen [of] *Bel. mucronata* from the Upper Campanian of Bielegorowka near Lessicansk (NW margin of the Donetz basin) figured in J. A. Jeletzky's paper (1948c, pl. XX, fig. 2a-b). The present writer describes similar forms under the name of *Bel. mucronata* Jeletzky (non Schlotheim), 1948."

The writer considers that Arkhangelsky's (1912, pl. IX, figs. 3, 9; pl. X, fig. 10) specimen concerned is undoubtedly a true representative of the genus *Belemnitella* and of species *B. mucronata* as currently interpreted (see para. 4-7 of this appeal). It shows, indeed, the typical *Belemnitella*-like character of the main vascular imprints branching off the double dorso-lateral furrows in the posterior part of the flank (Arkhangelsky, 1912, pl. IX, fig. 9). Considering the characteristic shape of the guard and its Upper Campanian age (*Belemnitella mucronata* zone; Jeletzky, 1958, p. 38-48) of this specimen, there can be little doubt about its true generic and specific nature. This specimen is, however, definitely lost according to Doctors D. P. Naidin (written communication to the writer of September 30th, 1957) and P. N. Varfolomeev (a subsequent written communication to Dr. Fr. Schmid communicated by the latter colleague to the writer on October 2nd, 1963) who had made a special search for it in all major collections of Moscow and Leningrad. It would, therefore, be quite inadvisable to propose this specimen as the substitute type of *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912.

The alternative type specimen proposed for *Belemnites mucronatus* Link, 1807 sensu Arkhangelsky, 1912, by Kongiel (1962, p. 30) is rather inappropriate in representing the extremely short and corpulent form of the species known under the name *Belemnitella mucronata* mut. senior Nowak, 1913. Although this form is but an extreme variant of the species concerned according to Jeletzky (1951b, 1958, p. 44-45) it certainly is not typical of it; it is, furthermore, a valid taxon of its own under the Rules. Kongiel's (1962, p. 30) choice of type specimen for *Belemnites mucronatus* Link, 1807 sensu Arkhangelsky 1912 lacks, finally, any validity under the Rules as he proposes to recognize J. A. Jeletzky as the author of *Belemnitella mucronata* sensu Arkhangelsky, 1912 instead of Link (1807).

In view of the above circumstances it seems best to propose as a neotype a specimen from a well known section of the Upper Campanian age personally studied by the writer and preserved in one of the internationally known palaeontological museums. This course is followed in this *Appendix*.

Type Reference. The specimen reproduced photographically in pl. 1, figs. 1A to 1D inclusive is herewith proposed as a neotype of *Belemnites mucronatus* Link, 1807 and its typical subspecies *Belemnitella mucronata* (Link, 1807) *mucronata* Naidin, 1956. This specimen was collected by Mr. A. W. Rowe from the *Belemnitella mucronata* zone s. str. (=Upper Campanian) at Norwich, Norfolk,

England. The locality is the Edward's Pit at Household Heath (Pit 160 of Rowe's Ms) (? St. James Hill). The specimen forms part of Mr. A. W. Rowe's collection purchased by the British Museum (Natural History) in November, 1926. The exact level within the chalk pit is not known either for this or for any other belemnite specimen of this collection. The specimen is preserved in the palaeontological collections of the British Museum (Natural History), Cat. No. BM-C.43542.

Description

Guard is large for the species and subspecies and so presumably full grown. It is almost complete in the alveolar part as its wall is only 2·3 mm. thick at the top. The preserved total length of the guard (107·5 mm.) is, nevertheless, well below the maximum preserved length of the guard (about 135 mm.) known for the species and subspecies. The guard is rather slender for the genus and species as illustrated by the ratio of its relative length (Nowak, 1913; Kongiel, 1962, p.10) to the dorso-ventral diameter at the base of the ventral fissure of 5·1.

The cross-section of the alveolar end is almost perfectly rounded with the dorso-ventral diameter slightly exceeding the lateral diameter. The guard's cross-section remains nearly circular and but slightly compressed laterally throughout its anterior half. At the base of the ventral fissure, for example, the dorso-ventral diameter is 17·3 mm. as compared with the lateral diameter of 17·1 mm. The lateral compression is almost absent here as illustrated by the ratio of the diameters of 1·01.

In the lower half of the guard it becomes somewhat compressed dorso-ventrally with the lateral diameter always exceeding the dorso-ventral diameter. At the level 36 mm. above the apex, for example, the dorso-ventral diameter is reduced to 14·4 mm. as compared to the lateral diameter of 17·1. The resulting ratio of the diameters is only 0·84.

The ventral surface of the guard is only slightly flattened in its upper half and somewhat more noticeably so in its lower half. The so-called dorsal field of the guard confined between the double dorso-lateral furrows and longitudinal depressions of the same is fairly markedly flattened, except in the proximity of the alveolar end where it becomes appreciably arched.

In ventral aspect the guard is almost cylindrical except in its lower third. No contraction has been noted at the base of the alveolus or thereabout. The downward tapering of the guard is almost imperceptible throughout its anterior half; it becomes somewhat more distinct in the lower half where it gradually increases toward the apex until it becomes fairly marked at the level about 20 mm. above the apex. Rapid but regular contraction ensuing 3 to 4 mm. above the apex results in a narrow but obtuse and regularly rounded apical end of the guard. A centrally located, well defined, small mucro, part of which is broken off, is superimposed on this latter.

In lateral aspect the guard is very high conical throughout; it tapers gently and evenly all the way from its alveolar end to the point about 3 mm. above the apex. Further down it contracts rapidly to form the already described apical end and mucro, which have the same appearance in the lateral as in the ventral aspect.

In dorsal aspect the guard has essentially the same shape as in the ventral aspect.

The surface of the guard is covered by the, mostly numerous and closely spaced, transverse to more or less oblique, strongly ramifying vascular imprints and by more or less numerous and crowded, short, slightly wavering, longitudinal striae.

The vascular imprints are most strongly and densely developed on the ventral and both lateral sides of the guard. On each side the principal vascular imprints originate in or at the double dorso-lateral furrows, dorso-lateral depressions and single lateral furrows. Most of them extend therefrom toward the ventral side of the guard throwing off numerous, complexly bent branches and becoming finer and finer and more and more crowded in this direction. The two sets of vascular imprints meet, intertwine and often join with the ends of their branches near the centre of the ventral surface of the postfissural part of the guard. An extremely complex vascular pattern results therefrom. The fine vascular branches form an especially dense net and are most strongly developed around the ventral fissure and farther down on the anterior half of the ventral side of the guard. Some of these vascular imprints enter the ventral fissure from both sides and appear to join the furrows covering the surfaces of its ostracumlamelles (Jeletzky, 1946). The longitudinal striae are relatively weak and scarce on the lateral and ventral surfaces of the anterior part of the guard. Their intersection with the vascular imprints mostly results only in a feeble crosshatching of the latter but not in a distinct granulation of the guard's surface. Only in a few small areas of the ventral surface closely below the base of the fissure does this intersection result in the appearance of some ill-defined and irregularly shaped granules (pseudogranules of Kongiel, 1962, p. 11).

On the lateral and ventral surfaces of the posterior half of the guard the vascular imprints become weaker and weaker and simultaneously less and less closely spaced toward the apex. The longitudinal striae, on the contrary, become more and more pronounced, numerous and closely spaced until they become the dominant element of the ornament in the interval between the apex and the level 28–29 mm. above it. In this interval the ornamentation is, furthermore, generally much weaker than farther orad; it resembles strongly that of *B. praecursor* var. *mucronatiformis* or *B. langei* s.str.

Only rare, weak and indistinct vascular imprints and no longitudinal striae have been observed within the dorso-lateral longitudinal depressions.

The dorsal field of the guard is much more weakly sculptured than the venter and flanks of the anterior part of the guard. Its alveolar third is semi-smooth with weak, relatively widely spaced vascular imprints and extra fine longitudinal striae being about equally prominent. The middle third of the dorsal field is more strongly ornamented; its ornamentation is, nevertheless, considerably weaker than that of the corresponding parts of the flanks and venter. In this part of the dorsal field fairly weak and broadly spaced vascular imprints are more strongly developed than the longitudinal striae. The latter are, however, coarser and stronger than those of the anterior third of the dorsal field. On the apical third of the dorsal field, finally, the similarly developed longitudinal striae

are the dominant element of the ornament just as they are on the corresponding parts of the venter and flanks.

The double dorso-lateral furrows are shallow, thin (about 0·33 mm. each) and closely spaced. The intervening rounded ridge is from 0·33 to 0·6 mm. wide. These furrows are only clearly developed within the posterior third of the guard where they are directly incised into the regularly rounded surface of the latter; they begin 5 to 6 mm. above the apex. Within this interval the double dorso-lateral furrows are essentially *Belemnitella*-like in their habit. Although they follow a slightly undulating course locally, they lack closely spaced, much more pronounced bends characteristic of *Belemnella* species. A few feeble vascular imprints, which are not visible on the photographs, branch off these furrows in the posterior quarter of the guard under acute angles not exceeding 25°. This is another *Belemnitella*-like feature.

Over the anterior two-thirds of the guard the double dorso-lateral furrows are considerably broader but mostly indistinct; within this interval they are situated on the bottom of broad dorso-lateral depressions. A third, more narrow dorso-lateral furrow occurs near the dorsal margin of each of these depressions throughout this interval. The intervening flat-topped ridge between the double furrows is at least 2·5 mm. wide within the depressions.

The dorso-lateral, longitudinal depressions are asymmetrical in cross-section, their dorsal slope being considerably steeper and much deeper incised than the ventral slope. It is not over 0·5 mm. deep, however.

Dorso-lateral longitudinal depressions gradually widen orad from 2 to 2·5 mm. at their lower end to 5·5 to 6 mm. at the alveolar rim of the guard; they become, however, more and more shallow in this direction. The gradual anterior widening of the dorso-lateral depressions results in corresponding narrowing out of the anterior part of the flattened dorsal side of the guard known under the name of the dorsal field in the same direction. The dorsal field is 13·5 to 14 mm. wide at the posterior end of the depressions (at the level 45 mm. above the apex) and only 8·5 mm. wide at the alveolar rim of the guard; it is, however, distinctly arched near the alveolar rim while being only slightly arched further apicad.

The single lateral furrows follow a zigzag course on the flanks of the anterior half of the guard. In their posterior parts these furrows run distinctly obliquely forming an angle of 8° to 15° with the longitudinal axis of the guard and gradually approaching the dorso-lateral depressions orad. At the level between 66 and 68 mm. above the apex unusually strong, subtransversal vascular furrows branch off the lateral furrows and connect them with the ventral rims of the longitudinal depressions; they form angles of 60 to 70° with the longitudinal axis of the guard. Farther orad several such furrows occur at irregular intervals on both flanks. The single lateral furrows gradually become weaker orad and are difficult to recognize near the alveolar rim of the guard.

The alveolus is regularly conical; it is 48 mm. deep and so comprises 0·44 of the total preserved length of the guard. The alveolar angle measured dorso-ventrally comprises about 18°. The inner surface of the conotheca is smooth, except for indistinct imprints of the septa. No traces of any ornamentation of conotheca, such as was observed by Jeletzky (1955, p. 484, pl. 56, fig. 4) near

the apex of the alveolus of *B. praecursor* sens. lat., were seen. This could, however, be due to the somewhat weathered state of the surface of the conotheca in our specimen. A longitudinal dorsal furrow of usual appearance occurs in the middle of the dorsal surface of the conotheca.

The alveolar fissure is relatively short; its preserved part is only about 20 mm. long and so comprises only about 41% of the preserved length of the alveolus. The Schatsky Index is 9·0 mm. The bottom of the ventral fissure is essentially straight, except for a slight bend in the middle which somewhat diminishes its angle with the alveolar wall closer to the surface of the guard. A sharp outward bend of the bottom occurs, however, just beneath the surface of the guard. The bottom of the ventral fissure forms an angle of 10° to 11° with the inner wall of the alveolus. A small, almost perfectly rounded protoconch occurs at the apex of the alveolus.

The apical line is situated somewhat closer to the ventral side of the guard; it is essentially straight, except in the lower third of the stem region where it deviates gradually and but slightly toward the dorsal side of the guard.

The outlines of juvenile guards are too imperfectly visible on the surface of the split up guard to be either photographed or drawn. Those parts of them that are visible, however, are enough to show that the ontogenetic development of the guard BM-C-43542 was essentially similar to that of the somewhat more slender topotype BM-C-43545 shown in pl. 1, fig. 4C and in text-fig. 1. In this latter specimen the first visible juvenile guard (which barely surrounds the protoconch) is nail-like, or perhaps better wedge-like, in lateral aspect. The total length of this guard is about 15 mm.; its length below the protoconch is about 9 mm. whilst its dorso-ventral diameter at the protoconch's level is about 1·5 mm. The earliest growth-stages of our form are, thus, rather slender and similar to those of *Belemnitella* n.sp. aff. *mucronata* Jeletzky (1948b, text-fig. 2) rather than to the much shorter and sturdier growth-stages of *Belemnitella mucronata* mut. *senior* Nowak.

The older juvenile guards retain similarly slender proportions at least until they reach the total length of about 62 mm. At that length the juvenile guard of BM-C-43545 has the length below the protoconch of about 37 mm. and the dorso-ventral diameter at the protoconch's level of about 7 mm. This juvenile guard still lacks any traces of a mucro; it already has, however, a subcylindrical outline, except in its acute and long apical region. The next clearly visible, half-grown guard of BM-C-43545 (see text-fig. 1) has the length below the protoconch of about 67 mm. and the dorso-ventral diameter at the protoconch's level of 13·5 mm. This guard is already quite similar to the adult guards of the specimens BM-C 43542 and 43545 so far as the proportions, shape, and the mucronated appearance of its apical end in the lateral aspect are concerned.

In the specimen BM-C-43542 the last non-mucronated and acute-pointed juvenile guard apparently has the length below the protoconch of about 38 mm.

Type Series. In addition to its proposed type-specimen (pl. 1, fig. 1A-1D), the writer was able to study twenty-one topotypes of *Belemnitella mucronata mucronata*. The majority of these are large, presumably full grown, almost complete representatives of our form. The range of morphological variation within this series is illustrated by two large guards shown in pl. 1, figs. 3-4

representing its morphological extremes. The type itself (BM-C-43542; pl. 1, fig. 1) is a morphologically intermediate ("mean") form.

The specimen shown in pl. 1, figs. 3A, 3B is a considerably sturdier and stronger sculptured form than the proposed type of the subspecies. It shows, furthermore, a slight contraction of the guard at the level of the lower end of ventral fissure in ventral and dorsal aspect; its ventral and dorsal surfaces are, finally, more markedly flattened and compressed than those of the proposed type specimen. In all other respects, including the value of the Schatsky Index (8-8.5 mm.) and the appearance of the bottom of ventral fissure, this specimen does not differ materially from the latter. It is, on the whole, morphologically similar to the early forms of *B. mucronata mucronata* figured by Jeletzky (1955, pl. 57, fig. 1a, 1b) and also resembles somewhat *B. mucronata senior* (see Jeletzky, 1955, pl. 57, fig. 5a, 5b; this note, pl. 1, figs. 2A, 2B).

The specimen reproduced in pl. 1, figs. 4A-4C is considerably more slender and longer than the proposed type-specimen. It is, furthermore, slightly "waisted" in ventral and dorsal aspects and tapers less in the lateral aspect. Its ventral fissure is, finally, noticeably longer than those of two other figured specimens.

In all other features, including the Schatsky Index (9.5-10 mm.) and the outline of the bottom of ventral fissure (pl. 1, fig. 4C) this specimen does not differ materially from the proposed type specimen. The here discussed specimen is, on the whole, transitional to *Belemnitella minor*; it differs, however, from this latter in its small fissure angle and the essentially straight outline of the bottom of ventral fissure.

Horizon and Age. The exact level from which the specimen BM-C-43542 and other Household belemnites have been collected is unknown. Nor is the level of the Edward's pit within the restricted *Belemnitella mucronata* zone (= Upper Campanian) known, except that it is somewhere within its upper half. The composition of the Household belemnite collection studied is deemed, however, to be sufficient to answer this question.

Large and typical representatives of *B. mucronata mucronata* Naidin, 1956, predominate in the collection studied. *B. mucronata senior* Nowak, 1913 is, on the contrary, absent. Even the transitional forms between *B. mucronata mucronata* and *B. mucronata senior* are rare. The predominant typical representatives of *B. mucronata mucronata* are, at the same time associated with less numerous transitional forms between *B. mucronata mucronata* on the one hand and *B. sp. n. aff. mucronata* Jeletzky 1948, *B. minor* Jeletzky, 1951 and *B. langei* Jeletzky 1948 s.str. on the other. Rare, more or less typical representatives of *B. langei* Jeletzky, 1948, *B. minor* Jeletzky, 1951 and *B. lanceolatus* Sharpe, 1857 non Schlotheim, 1813 are also present.

Provided that only one belemnite fauna is represented in this collection, the Household belemnite fauna corresponds approximately either to that occurring in the topmost beds of *Belemnitella mucronata* mut. *senior* zone or to that of the basal beds of *Belemnitella* sp. n. aff. *mucronata* Jeletzky, 1948 zone of the Dniepr-Donetz basin (Jeletzky, 1958, p. 38-48, table opp. p. 112). A position somewhat above the middle of the British *Belemnitella mucronata* zone (in restricted sense of Wright & Wright, 1951) appears to be indicated. The writer

would suggest the top part of Weybourne Chalk of Peake & Hancock (1961, p. 317, 319) as the most likely source of this belemnite fauna.

Judging by the stratigraphical information provided by Mr. Leslie Bairstow (considerable thickness of chalk exposed in the pit 160 and Mr. A. W. Rowe's practice of amalgamating all fossil collections made in any single pit) more than one belemnite fauna could well be represented in the Household collection studied. Should this be so, the large and typical representatives of *B. mucronata mucronata* should be older than the other belemnite forms of the same collection and would most likely represent some level within the top part of *B. mucronata* mut. *senior* zone as defined by Jeletzky (1958, p. 38-48). It should be noted in this connection that Naidin (1956, p. 19) has already suggested that the Russian representatives of *B. mucronata mucronata*, which are indistinguishable from its Household representatives (see Arkhangelsky, 1912, pl. IX, figs. 3, 9; pl. X, fig. 10; Naidin, 1959, text-fig. 23), probably occur in a subzone of their own. According to him, this subzone overlies the subzone of *B. mucronata senior* and underlies that characterized by belemnite forms transitional to *B. langei* sens. lat.

The proposed neotype of *B. mucronata mucronata* and all of its studied topotypes are, at any rate, "high" forms of this subspecies (in sense of Jeletzky, 1955, p. 480, text-fig. 1) often approaching *B. minor* Jeletzky, 1951 in their morphology.

Comments on Belemnitella mucronata mucronata Naidin, 1956. Naidin (1956, p. 19; 1959, p. 203-4) and Jeletzky (1958, p. 45) have already proposed a subspecific name *Belemnitella mucronata mucronata* for the *Belemnitella* form typified by the above described Household specimen. The type specimen of the species being automatically the type of the nominate subspecies, the subspecies *mucronata* is dated from Naidin (1956). The proposed substitution of type of the species also will automatically substitute it for the nominate subspecies (see Code Art. 61a).

The following previously published guards can, in the writer's opinion, be identified as *B. mucronata mucronata* Naidin, 1956.

Belemnitella mucronata, Moberg, 1885, pl. VI, fig. 13 (not others).

Belemnitella mucronata, Arkhangelsky, 1912, pl. IX, figs. 3, 9; pl. X, fig. 10.

Belemnitella mucronata, unnamed early variety, Jeletzky, 1955, p. 480, text-fig. 1; pl. 57, fig. 1a, 1b.

Belemnitella mucronata mucronata, Naidin, 1956, p. 19.

Belemnitella mucronata (sensu Arkhangelsky, 1912 only), Birkelund, 1957, p. 30-31.

Belemnitella mucronata var. *mucronata*, Jeletzky, 1958, p. 45.

Belemnitella mucronata, Nikitin, 1958, p. 17-19, pl. VII, figs. 1-5; pl. VIII, figs. 1, 3; pl. IX, figs. 1, 2; pl. X, fig. 1.

Belemnitella mucronata mucronata, Naidin, 1959, p. 203-4, text-fig. 23.

Belemnitella mucronata, Kongiel, 1962, p. 29-30, 92-95, pl. XVIII, figs. 10-12 (not others).

As pointed out by Jeletzky (1955, p. 480, text-fig. 1), the widespread and prolific form herein named *B. mucronata mucronata* is actually a morphologically intermediate ("mean") form of the *Belemnitella mucronata* species group connecting its morphologically extreme forms, such as *B. mucronata senior*,

B. mucronata elegans, and *Belemnitella* sp.n. aff. *mucronata* Jeletzky 1948 with one another. It is at the same time much more closely allied to the above mentioned early forms of the *B. mucronata* species group and to *B. praecursor* sens. lat. than to its younger members, such as *B. langei* Jeletzky, 1948 non Birkelund, 1957, *B. minor* Jeletzky, 1951, *B. lanceolatus* Sharpe, 1857 non Schlotheim, 1813 (= *B. langei* Birkelund non Jeletzky, 1948) and *B. junior* Nowak s. str.

Like all the above mentioned early (late Lower to mid-Upper Campanian) representatives of the *B. mucronata* species group, *B. mucronata mucronata* is characterized by the essentially straight course of the bottom of the ventral fissure, small fissure angle, which usually does not exceed 20°, and a relatively short ventral fissure.

All the above mentioned younger (mid-Upper Campanian to Maastrichtian) representatives of the *B. mucronata* species group have, on the contrary, a more or less complexly bent bottom of the ventral fissure and a large fissure angle, which normally exceeds 40° and may reach 120°. Their ventral fissure is accordingly relatively (to the depth of the alveolus) longer than that of *B. mucronata mucronata* and its allies.

As repeatedly stressed by the writer (Jeletzky, 1951, p. 80; 1955, p. 480–91, text-fig. 1; 1958, p. 33, 42–43), all possible transitional forms between the representatives of these two form-groups are present in the mid-Upper Campanian rocks of all European countries.

The morphological distinctions of *B. mucronata mucronata* from *B. praecursor* sens. lat. have already been discussed by Jeletzky (1955, p. 496–7, expl. of pl. 57, fig. 1).

B. mucronata senior Nowak, 1913 is a much more corpulent and short form than *B. mucronata mucronata*. This difference is apparent at once in the specimens of these two forms shown in pl. 1 of this paper and in that of Jeletzky (1955, pl. 57, figs. 1, 5). It is best expressed quantitatively in the rather different ratios of the relative length of the guard to its dorso-ventral diameter at the base of alveolar fissure. The contrast between the slender and corpulent shape of the guard of the forms concerned is also observable in their juvenile and half grown guards. These growth stages of *B. mucronata mucronata* are always much more slender than the corresponding growth-stages of *B. mucronata senior* and closely comparable to those of *B. minor* and *B. sp.n. aff. mucronata* Jeletzky, 1948. Another distinction consists in the considerably stronger development of the vascular imprints on the posterior half of the guard of *B. mucronata senior*. The apical end of *B. mucronata senior* is finally considerably broader and more obtuse than that of *B. mucronata mucronata*. As already mentioned, however, all these distinctions are only valid for the typical representatives of both forms; their numerous transitional forms can only be designated as such.

B. sp.n. aff. mucronata Jeletzky, 1948b (text-figs. 1–2) differs from *B. mucronata mucronata* in the marked to pronounced dorso-ventral compression and flattening of its guard. Its guard is, furthermore, strongly to moderately lanceolate in ventral aspect and feebly lanceolate to subcylindrical in lateral

aspect. The Schatsky Index of *B. sp.n. aff. mucronata* Jeletzky, 1948 tends, finally, to be smaller (4·5 to 6 mm.) than that of *B. mucronata mucronata* (6 to 10 mm.). There is, however, a considerable overlap in the values of this feature, especially where the transitional forms are concerned. The two forms concerned are, as a rule, indistinguishable in their fissure angles and in the shapes of the bottoms of their fissures. The same is true, furthermore, of the appearance of the juvenile and half-grown guards of *B. mucronata mucronata* and *B. sp.n. aff. mucronata*. It is for that reason that the writer includes the latter among the early rather than late representatives of *B. mucronata* species group.

B. mucronata mucronata and *B. sp.n. aff. mucronata* are connected by all possible transitional forms wherever their time ranges overlap (see Jeletzky, 1955, text-fig. 1, pl. 57, fig. 1).

Belemnites lanceolatus Sharpe, 1857 non Schlotheim, 1813 differs from *B. mucronata mucronata* in its much feebler sculpture and the weaker development of the mucro and abbreviated apical end of the guard; it is, furthermore, a distinctly lanceolate form with an apparently greater fissure angle.

B. mucronata elegans Wassilenko & Rasmussen, 1950 is, so far as we know (see Jeletzky, 1958, p. 44–45), a smaller, more slender and distinctly lanceolate form than *B. mucronata mucronata*; it seems to lack, however, the pronounced dorso-ventral compression and flattening of *B. sp.n. aff. mucronata* Jeletzky, 1948 and its lesser value of Schatsky Index. The early forms of *B. mucronata mucronata* (see Jeletzky, 1955, pl. 57, fig. 1) are often similar to *B. mucronata elegans* in the general shape of their guards.

As here defined, *B. mucronata mucronata* is a long-ranging form. Its earliest known representatives appear rarely already in the middle and upper parts of the so called *Pteria*-beds of SW Russia (Jeletzky, 1958, p. 33). It becomes rather common already in the uppermost Lower Campanian beds with *B. mucronata senior* and *Actinocamax cf. mammillatus* (Jeletzky, 1958, p. 42–43). The same is probably true of all the Scandinavian countries, northern Poland, northwestern Germany and England. It is not known whether *B. mucronata mucronata* occurs in the mid- to late Lower Campanian rocks of Belgium, France and middle Poland (Vistula profile) and it is quite possible that it did not penetrate into these regions until the earliest Upper Campanian time.

B. mucronata mucronata abounds in the early to mid- Upper Campanian rocks of northern Eurasia from the Urals to Great Britain (including Northern Ireland). It becomes scarce and possibly disappears completely already in the middle part of *Belemnitea* sp.n. aff. *mucronata* Jeletzky, 1948, zone by transmutation into *Belemnitella minor* Jeletzky and *Belemnitella ex aff. langei* Jeletzky, 1948 non Birkelund, 1957. Its records from younger beds are probably due to the confusion with extremely sturdy and subconical representatives of *B. minor*. The latter differ, however, from *B. mucronata mucronata* in their considerably longer ventral fissure, larger fissure angle and more or less complexly bent bottom of the ventral fissure. More careful bed by bed collecting is needed, however, to establish the upper age limit of *B. mucronata mucronata*.

The general appearance of the guards of *B. mucronata mucronata* changes appreciably within its known time range. So far as is known its evolutionary trend is the same from Central Russia to England. The late Lower and earliest

Upper Campanian representatives of *B. mucronata mucronata* are distinctly sturdier and shorter and have a deeper alveolus than its younger (e.g. Household) representatives. Their shape of the guard is, at that, often less regular and the sculpture stronger. These early forms of *B. mucronata mucronata* are on the whole more similar to *B. mucronata senior* and *B. mucronata elegans* than are its younger representatives. The latter are, on the contrary, more similar to *B. minor*, *B. sp.n. aff. mucronata* Jeletzky, 1948, and the early allies of *B. langei* Jeletzky non Birkelund. For the time being at least, these "low" and "high" forms of *B. mucronata mucronata* are kept together as members of one and the same subspecies of *B. mucronata* sensu Arkhangelsky, 1912. There is a distinct tendency, however, to consider the "high" forms as typical of the subspecies (e.g. Naidin, 1956, p. 19; 1959, p. 203-4, text-fig. 23). The writer has followed this tendency in designating a "high" form as the neotype of the subspecies.



Text-fig. 1. *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912 subsp. *mucronata* Naidin, 1956. British Museum (Natural History), London, coll. no. BM.C-43545.

A schematical drawing of the ontogenetic development and other internal features of the longitudinally split (lateral view) guard shown in pl. 1, fig. 4C. Natural size.

EXPLANATION OF PLATE 1

All figures natural size

- Figs. 1A-1D. *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912 subsp. *mucronata* Naidin, 1956. The proposed neotype. British Museum (Natural History), London, coll. no. BM.C-43542. Norwich Chalk, *mucronata* zone in restricted sense (upper Campanian), Norfolk, England, Edward's Pit at Household (Pit - 160 of A. W. Rowe's Ms.) (? St James Hill). Collected by Mr. A. W. Rowe.
 1A. Ventral view; 1B. Dorsal view; 1C. Lateral view; 1D. Lateral view of the inside of longitudinally split guard.

- Figs. 2A. 2B. *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912 subsp. *mucronata* Naidin, 1956. A sturdy variant of the subspecies. British Museum (Natural History), London, coll. no. BM.C-43544. Same locality, collector, etc. as for the specimen BM.C-43542.
 1A. Ventral view; 1B. Lateral view.

- Figs. 3A-3C. *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912 subsp. *senior* Nowak, 1913. A medium-sized specimen. Author's private collection at the Geological Survey of Canada, Ottawa, Ontario.
 Natural portland cement marl's unit. Early Upper Campanian, *Hoplitoplacenticeras* (= *Dechenoceras*) *coespeldiense* zone. Greater cement pit at Amvrossievska, Stalino province, Ukrainian SSR, USSR, southern margin of Donets basin. This specimen was reproduced graphically by Jeletzky (1951b, pl. 2, figs. 1a, 1b.
 1A. Ventral view; 1B-1C. Two lateral views. The specimen is somewhat deformed (lateral compression) near the alveolar rim.

- Figs. 4A-4C. *Belemnitella mucronata* (Link, 1807) sensu Arkhangelsky, 1912 subsp. *mucronata* Naidin, 1956. A slender variant of the subspecies transitional to *Belemnitella minor* Jeletzky in the shape and proportions of its guard, length of ventral fissure, etc. British Museum (Natural History), London, coll. no. BM.C-43545.
 Same locality, collector, etc. as for the specimen BM.C-43542.
 1A. Ventral view; 1B. Lateral view; 1C. Lateral view of the inside of longitudinally split guard. Compare with text-fig. 1.

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